

DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN AND RELATING TO DISPOSABLE SANITARY NAPKINS

- (71) I, KOICHI NOGUCHI, a subject of Japan, residing at 54-6, 1-Chome, Yoyogi, Shibuya-Ku, Tokyo, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- This invention is concerned with improvements in and relating to disposable Sanitary Napkins, particularly for use in menstruation. When napkins having cotton-wool absorbents currently on the market are thrown into water in a water closet bowl, they tend to clog the drain of the water flush system because the fibres of the absorbent do not swell/disperse or dissolve/disperse. Therefore such napkins are not suitable for disposal into water in a water closet bowl after their use.
- By "swell/disperse" we mean that the fibres swell on contact with a liquid and as a result contract in length, the contraction causing the fibres to disentangle and eventually disperse in the liquid. By "dissolve/disperse" we mean that, in addition to the "swell/disperse" effect, the fibres partially dissolve in the liquid, thus speeding up the eventual dispersion.
- The object of this invention is for the absorbent of a sanitary napkin to maintain its form without dissolution on absorption and storage of menstrual fluid during its use, but will also dissolve/disperse and swell/disperse quickly when the napkin is thrown into water in a water closet bowl after use. This is achieved by using short fibres of carboxy methyl cellulose as the basic raw material of the absorbent. Carboxy methyl cellulose (hereinafter abbreviated as CMC) is not soluble in water. However, in alkaline water solution, CMC becomes alkaline CMC and dissolves. This property is applied to the absorbent of the napkin in this invention.
- According to one aspect of the present invention there is provided a sanitary napkin comprising (1) an absorbent pad formed from a fibrous mass containing:
- (a) at least 10% by weight of carboxy methyl cellulose fibres having a fibre length of less than 1 cm, a degree of etherification of 0.15 to 1.50 and an average degree of polymerisation of more than 100,
- (b) 0 to 30% by weight of alkaline carboxy methyl cellulose fibres, and
- (c) 0 or less than 70% by weight of short fibres which do not dissolve in or react with alkaline solution, and (2) a solid alkaline agent having a pH of below 10 in aqueous solution at 0.1 mol concentration and room temperature.
- According to another aspect of the present invention there is provided a sanitary napkin comprising (1) an absorbent pad formed from a fibrous mass containing:
- (a) at least 10% by weight of carboxy methyl cellulose fibres having a fibre length of less than 1 cm, a degree of etherification of 0.10 to 1.50 and an average degree of polymerisation of more than 100,
- (b) 0 to 30% by weight of alkaline carboxy methyl cellulose fibres, and
- (c) 0 or less than 70% by weight of short fibres which do not dissolve/disperse in alkaline solution; and (2) an alkali source comprising solid alkali carbonate and a solid acid.
- It is necessary for the absorbent of the napkin to be basically a fibrous mass of CMC short-fibres. The reasons for this are that a fibrous mass of CMC does not give the wearer a disagreeable feeling during use because of its soft pliability; it has a property of good absorption of menstrual fluid and good storage of absorbed menstrual fluid because of its porosity; also it has a good property of chemical reaction in that it dissolves and dis-

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perses instantly in weak alkaline aqueous solution.

It is generally very difficult to convert CMC to carboxy methyl cellulose alkali (hereinafter called as Na-CMC, taking sodium carboxy methyl cellulose as the most representative of carboxy methyl cellulose alkalis) quickly, and for this purpose a strong alkali such as caustic soda (NaOH) and lengthy reaction times, as well as such treatment as heating, stirring etc. are necessary. However, when the CMC is in a fibrous mass, it reacts well to weak alkaline aqueous solution while standing at normal temperature. The reason for this is the structure of the fibrous mass being such that CMC short fibres are closely entangled but without being combined, and so has large voids. The alkaline aqueous solution is immediately absorbed into the fibrous mass when it is thrown into an aqueous alkaline solution, so that the entire surface area of the CMC short-fibres contact the solution, and consequently the reactivity of the fibrous mass to the solution is greatly increased.

CMC short fibres swell quickly when contacted with an alkaline aqueous solution and the degree of swelling (hereinafter called as DS) of CMC short fibres increases in proportion to the degree of etherification (hereinafter called as DE). Thereby the lengths of the CMC fibres are shortened and the linear structure is destroyed. As well as swelling, the CMC short-fibres react with an alkaline aqueous solution and partly dissolve because of the change of CMC to Na-CMC. To sum up, the CMC fibrous mass reacts to an alkaline aqueous solution by shrinkage of length, swelling, decomposition and dissolution of the CMC short fibres. The entanglement of the CMC short fibres forming the fibrous mass is loosened and eventually the fibres disentangle so that the fibrous mass dissolves/disperses and swell/disperses in the alkaline aqueous solution.

It has been shown by experiments that CMC materials of high density such as CMC-paper or CMC gauze, dissolved in strong alkaline solution of a strong alkali, the pH (at 0—1 mol concentration at normal temperatures—hereinafter, pH values are all under these conditions) of which is more than 12 e.g. NaOH, did not dissolve for a long time at normal temperature in saturated alkaline aqueous solution of sodium carbonate (Na_2CO_3), the pH of which is 11.5. On the other hand, a CMC fibrous mass reacts very easily dissolves, swells and disperses in a still aqueous solution of NaHCO_3 (pH 8.3) at normal temperatures. Since the alkaline agent to be used with a sanitary napkin should not be harmful to a human body, strong alkaline agents such as NaOH or Na_2CO_3 of which the pH is higher than 10, are dangerous and unfit to be used for the napkin of this invention. However,

NaHCO_3 (pH 8.3) which is not harmful to the human body, is effectively usable.

Next, it is necessary that the CMC fibres forming the fibrous mass are short fibres of lengths less than 1 cm. It has been shown by experiments that in a fibrous mass having fibres more than 1 cm long, the fibrous mass does not dissolve/disperse or swell/disperse (hereinafter referred to together as dissolve/disperse) in a weak alkaline aqueous solution of an alkaline agent of pH less than 10, due to the tight entanglement of the fibres. Therefore, in order to ensure easy and prompt dissolution/dispersion of a CMC fibrous mass in an alkaline aqueous solution of an alkaline agent of pH less than 10, it is necessary that the entanglement of the CMC fibres is loose and so the length of the CMC fibres is shorter than 1 cm.

Next, the effect of DE and average degree of polymerization (hereinafter called DP) of the CMC fibres forming the fibrous mass on the pliability, dissolution/dispersibility and swelling/dispersibility of the fibrous mass is explained hereunder:

Relationship between DE and Pliability.

On an increase in DE, the pliability is reduced and the CMC short fibres become harder and thus unfit for the absorbent. Because of this, there should exist a maximum limit value for DE. When the CMC short fibres become hard, their defibration becomes impossible. The maximum limit value of DE is about 1.5. Of course, the smaller the DE, the better the pliability.

Relationship between DE and Solubility/Dispersibility.

On an increase in DE, the degree of reaction of CMC fibres to an alkaline aqueous solution increases. That is, DE and reactivity are proportional i.e. DE and the solubility/dispersibility are proportional. On the other hand, when DE decreases and falls below a certain limit, the reactivity between CMC fibres and an alkaline aqueous solution decreases and the dissolution/dispersion of the fibrous mass becomes impossible. Thus, there should exist a minimum limit for DE.

Relationship between DP and Pliability.

On a decrease in DP, the fibres become fragile and lose pliability. Therefore, if DP is decreased too much, the linear structure of short fibres is destroyed. Thus, there should exist a minimum limit value for DP.

Relationship between DP and Solubility/Dispersibility.

On a decrease in DP, the dispersibility increases.

Summing up the above, it is necessary to control DE and DP in such a way as to maintain good pliability and solubility/dispersi-

bility so as to make the fibrous mass suitable for the absorbent of the napkin.

As the alkaline agent is required to be present within the napkin, it is necessary to be a solid alkaline agent convenient to be carried with and to be incorporated in the napkin. Also, it is necessary that the alkaline agent is not harmful to the human body and clothing. Since the alkaline agent is to be used by large numbers of people it should always be positively safe. Therefore, an alkali agent of pH higher than 10 cannot be used.

It must also be a weak alkaline agent that will not destroy bacteria causing putrefaction of night soil in a septic tank. As it is said that the pH necessary to keep bacteria alive in a septic tank is within the range of about 6—8, it should be a weak alkaline agent such as NaHCO_3 of which the pH is 8.3, in order to maintain the pH of the liquid in the septic tank within the range of 6—8.

When placed in, for example, a water closet bowl in combination with the solid alkaline agent, which for the reasons discussed above has a pH of below 10, or the alkali source comprising a solid alkali carbonate and a solid acid, the napkin of the invention is disposable by water flushing.

When the solid carbonate and solid acid are used, the turbulence caused in the water by emission of carbon dioxide stimulates the dissolution of the absorbent. This effect does not occur when the solid alkaline agent is used, and so for efficient dissolution of the absorbent the fibrous carboxy methyl cellulose has in that case a degree of etherification of from 0.15 to 1.50.

Hereinunder are described sanitary napkins according to the invention having various combinations of absorbent and alkaline agent.

(1) Sanitary napkins comprising a combination of (a) an absorbent which is a fibrous mass of short-fibres of less than 1 cm in length of carboxy-methyl-cellulose of degree of etherification of 0.15 to 1.50 and of average degree of polymerization of more than 100, which may include up to but less than 70% by weight of fibres which do not dissolve/disperse in alkaline solution, and (b) a solid alkaline agent of which the pH is lower than 10 at 0.1 mol concentration and at room temperature.

When this napkin is disposed of, there may be a defect that, since the solid alkaline agent, when being thrown into water in a water closet bowl, sinks to the bottom of the bowl and commences dissolution there, the water in the upper part does not become alkaline for a short while after throwing the alkaline agent into the still water. Therefore, in this case, it is necessary to make the entire water alkaline quickly by stirring the water after throwing the alkaline agent or to delay the throwing of the napkin for a while until the upper part of the water becomes alkaline.

As for the DE and DP of the absorbent of the napkin in this paragraph, the maximum value of DE is 1.50 as aforementioned since the fibrous mass of the absorbent is made of defibrated short fibres. The minimum value of DE which is as aforementioned the lowest DE capable of dissolving/dispersing the fibrous mass quickly, may be within the range of 0.34—0.27 and generally about 0.30 in case of a normal degree of polymerization (DPs of more than 500 are called normal degree of polymerization) as illustrated in Example 1 below.

Next, it was mentioned before that the dispersibility of the fibrous mass increases with a decrease in DP and Example 2 below illustrates how far the minimum DE capable of dissolving/dispersing the fibrous mass may be decreased from the DE (about 0.3) of a normal degree of polymerization, by lowering the DP to less than the normal degree of polymerization. Also in Example 2, the optimum point in respect of the pliability of the fibrous mass suitable for absorbents was examined since the pliability of the fibrous mass is reduced when DP is decreased. There are various methods to decrease DP. For industrial purposes for making H—CMC fibres, DP may be arbitrarily controlled by adjusting the dipping time of raw material cellulose in NaOH solution in the process of making alkaline cellulose, i.e. the longer the dipping time the smaller the DP. In Example 2 CMC fibres were dipped in hydrogen peroxide (H_2O_2) and the resultant DPs were controlled by the lengths of this dipping time. In Example 2 a CMC fibrous mass of DE 0.27 and of DP 564 was used as test piece, this cotton-wool congregation did not dissolve/disperse in alkaline aqueous solution as mentioned in Example 1 but it did dissolve/disperse within about two seconds after being thrown into NaHCO_3 solution when its DP was decreased to 243 by dipping in H_2O_2 for 48 hours. Such being the case a CMC fibrous mass does not dissolve/disperse at normal DP but dissolve/disperses at decreased DP.

Using this property, Example 3 was carried out to find out the lowest DE at which the fibrous mass was dissolved/dispersed under the state of its DP being extremely lowered but within such a limit of DP that the shape of the fibrous mass is maintained (DP about 100—200). The test pieces used in this Example were fibrous masses of DP more than 500 which were dipped in H_2O_2 for 72 hours to decrease their DPs to the range of about DP 100—200 and the solubility/dispersibility was examined with the test pieces having smaller DEs. In this Example, a fibrous mass of DE 0.197 dissolved/dispersed quickly but those of DE 0.148 and DE 0.043 did not dissolve/disperse. From this, it has been ascertained that the minimum value of DE at which a CMC fibrous mass of DP 100—200 dis-

solves/disperses, was within the range of DE 0.197—0.148 and was about 0.15.

As for the cases in which short fibres which do not dissolve/disperse in alkaline aqueous solution are evenly mixed with the CMC absorbent of the napkin described above, it has been confirmed in Example 5, that the absorbent could dissolve/disperse when the mixing rate was less than 70%. The effect of mixing these "non-reactive" short fibres is that it is naturally economical to mix as much of these fibres as possible because they are cheaper than CMC short fibres.

As for the alkaline agent to be used in combination with the absorbent in this paragraph, it is necessary to be a solid alkaline agent which, as mentioned before in the paragraph of the conditions of alkali, is positively harmless to the human body and clothing and does not cause death of bacteria in a septic tank. For this reason, strong alkaline agents of pH more than 10 such as Na_2CO_3 , etc. may not be used in combination with the absorbent in this paragraph because of their likely hazard and trouble. Alkaline agents of pH lower than 10 are suitable as alkaline agents to be used in combination with the napkin in this paragraph because they are safe to human body and also, their pH in a septic tank will be lowered by the large quantity to be used for flushing. NaHCO_3 is one of the most suitable examples of the alkaline agent for this use.

(2) Next, explanations are made about a sanitary napkin comprising a combination of an absorbent which is a fibrous mass made by mixing up to 30% by weight of alkaline carboxy methyl cellulose fibres, with the fibrous mass described under (1) above and the same alkaline agent.

The absorbent of this napkin maintains its shape during its use for the absorption of menstrual fluid as long as the mixing of Na—CMC short fibres in the absorbent is within 30 percent but this mixing has the effect of preventing the binding of the short fibres of the absorbent to some extent. It has been ascertained by results of a test exercised by the inventor that the portion of the short fibres of the absorbent which are bound together by coagulation of menstrual fluid is only 5 per cent of the total and so it does not cause any trouble in the disposal of the napkin in its practical use. The experiment regarding the maximum permissible mixing ratio of NaCMC fibres is illustrated in Example 4.

(3) Next, explanations are made about a sanitary napkin comprising a combination of (a) an absorbent which is a fibrous mass of short fibres of less than 1 cm length of carboxy-methyl-cellulose of degree of etherification of 0.10—0.15 and of average degree of polymerization of more than 100, which may include up to but less than 70% by weight of short fibres which do not dissolve/disperse in

alkaline solution, but (b) an alkali source composed of a solid alkali carbonate and a solid acid.

For some time after the alkaline agent used for disposal of the previously mentioned napkin is thrown into the water in a water closet bowl, the upper part of the water does not change to alkaline state. Therefore, it may occur that even when the napkin is thrown into water after the alkaline agent is put into water, the absorbent of the napkin does not dissolve/disperse for a long time because it absorbs the water of the upper part and, the water staying still, the exchange of water in it with alkaline aqueous solution does not take place. However, when an alkali source composed of an alkali carbonate and an acid is used in combination with the absorbent in this paragraph, a large amount of CO_2 gas is generated by reaction of the alkali carbonate and acid after dissolving which agitates the water in the closet bowl and changes the water evenly to an alkaline state. Therefore in case of the napkin described in this paragraph, the absorbent dissolves/disperses quickly because, when the napkin is thrown into water after the alkali source is put into water, alkaline solution is pumped into the absorbent by CO_2 gas. Additionally, the alkaline source in this paragraph has the following features useful for disposal of napkins:

It has an effect of pushing out the menstrual fluid absorbed in the absorbent and thus making dissolution/dispersion of the absorbent easy. It is because CO_2 gases generated in a large quantity penetrate forcefully into the absorbent and push out the menstrual fluid already absorbed in the absorbent and, instead, deliver alkaline solution into the absorbent so that the absorbent may be dissolved/dispersed quickly. It has also improved the reaction between the absorbent and alkaline solution because CO_2 gases generated in a large quantity penetrate forcefully and continuously into the absorbent and as a result of this, the CMC fibrous mass absorbent contacts continuously fresh alkaline solution, improving dissolution/dispersion of the absorbent. Also, even when the alkalinity of the alkaline solution is weak, the absorbent dissolves/disperses easily in the alkaline solution.

Also, it has an effect that the absorbent dissolves/disperses in alkaline solution easily even when the order of throwing-in is reversed, and the napkin is thrown into a water closet bowl prior to the alkali source. As mentioned before, when the napkin is thrown into water prior to the alkaline agent, the water soaks into the absorbent end, even with the subsequent throw-in of alkaline agent into water, the exchange of the water in the absorbent with alkaline solution does not take place since the alkaline solution stays still and the absorbent does not dissolve/disperse for a long time.

However, with the alkaline source described in this paragraph, even when the napkin is thrown into water prior to the alkali source, the generation of a large amount of CO_2 gas causes quick exchange of the water in the absorbent with the alkaline solution and the absorbent dissolves/disperses quickly.

Also, as this alkali source contains an acid, the alkalinity due to the alkali agent is reduced and thus reduces the possibility of killing bacteria in domestic septic tanks.

This alkali source is entirely harmless to bacterias in septic tanks because pH of the water in the closet bowl may be perfectly controlled within a range of about 7.0—7.5 by adjusting the quantity of the acid to that of alkali carbonate.

The effects of using alkali source in combination with the absorbent are mentioned above and explanations are made hereinafter about the solid alkali carbonate and the solid acid composing this alkali source. Of course, a solid alkali carbonate and a solid acid harmless to human body and clothing should be employed and their dosages for use should be formulated beforehand to make the alkalinity of the water in the closet bowl within a range of pH about 7.0—7.5. Preferred is a combination of NaHCO_3 as alkali carbonate and citric acid as acid.

Next, as for the DE of the absorbent of the napkin in this paragraph, the minimum of value of DE at which the absorbent can dissolve/disperse is lower than that of DE of the absorbent of the aforementioned napkin (about 0.3) because the reactivity of the absorbent is improved by CO_2 gas. As shown in Example 6, the DE is about 0.15. The DP in this case is a normal degree of polymerization i.e. about 500—600 but if the DP is decreased lower than normal degree of polymerization, the DE is further lowered and it has been shown in Example 7 that the DE is about 0.10. The fact that the DE of the absorbent may be decreased by the use of the alkali source means that the pliability and sponginess of the absorbent is fully secured.

(4) Next, explanations are made about a sanitary napkin comprising of a combination of an absorbent which is a fibrous mass made by a mixture of up to 30% by weight of alkaline carboxy methyl cellulose fibres with the fibrous mass described under (3) above, and the same alkali source.

The special feature of this napkin is that, although the effect of mixing Na—CMC is same as that of the previously mentioned napkin, the dissolution/dispersion of the absorbent is quicker and more positive than that of the previously mentioned napkin since the alkali source is employed.

Next, is illustrated hereunder the Examples on which the foregoing explanations are based:

EXAMPLE 1

Experiment on the effect of DE on the ability of an absorbent of CMC fibres of less than 1 cm length to dissolve/disperse by combined use of the absorbent and the alkaline agent.

Kind of material. Wood pulp cotton-wool of defibrated short fibres.

Size, form and weight of material.

One gram in a cylindrical form of 2 cm in diameter and 2 cm in height.

State of material.

Under pressed condition, water is soaked in more than 2/3 parts of the cylinder.

Length of CMC short fibre materials.

Two to 4 millimeters.

DP of material. 500—600.

(DE of CMC) (State of dissolution/dispersion)

(1) 0.27 No dissolution/dispersion even after 30 minutes.

(2) 0.34 Dissolved/dispersed within about 2 seconds.

(3) 0.45 Dissolved/dispersed within about 1 second.

(4) 0.50 Same as above.

(5) 0.70 Same as above.

(6) 0.90 Same as above.

Comment: The minimum value of DE at which the material dissolves/disperses is between 0.27 and 0.34. It is about 0.30.

EXAMPLE 2

Experiment on dissolution/dispersion of a fibrous mass of CMC short fibres of DE 0.27 and DP 564, this DP having been decreased by immersion in H_2O_2 , the fibrous mass being thrown into water in combination with alkaline agent.

Material of DE 0.27 in Example 1 was employed in this Experiment.

Kind of material, size, form and state of material etc. were same as those in Example 1.

Weight of material. Five grams.

Length of CMC short fibres. Two to 4 millimeters.

H_2O_2 30 per cent concentration, 500 cc.

DP and DE of material before immersion in H_2O_2 , DE 0.27, DP 564.

Alkaline agent, NaHCO_3 10 grams.

H_2O 1,000 cc.

Time of dipping of material. Immediately after throwing alkaline agent into water and stirring up the liquid.

	Time of immersion of polymerization in H ₂ O	(Average degree of polymerization: DP)	(State of dissolution/dispersion)	
5	(1) 44	319	No dissolution/dispersion.	EXAMPLE 4 60
	(2) 48	243	Dissolved / dispersed within about 2 — 3 seconds.	4. Experiment on durability of maintaining the form of the absorbent during use when Na—CMC short fibres are evenly mixed in the absorbent of CMC short fibres. 65
10	(3) 52	227	Dissolved / dispersed within about 1 — 2 seconds.	Kind, form, weight state etc. of material. Same as those in Example 1.
15	(4) 56	213	Dissolved / dispersed within about 1 second. Most of material completely dissolved within about 1 minute.	Length of CMC short fibres. Two to 4 millimeters. 70
20	(5) 61	205	Same as above.	Length of Na—CMC short fibres. Two to 4 millimeters.
	(6) 69	151	Same as above.	Alkaline agent. NaHCO ₃ 10 grams.
	(7) 81	132	Same as above.	H ₂ O 1,000 cc.
	(8) 95	110	Same as above.	Time of dipping of material. Immediately after throwing alkaline agent into water and stirring up the liquid. 75
25	Comment: Immersion for 48 hours provides DP 243 and from this DP, dissolution/dispersion commences and all the materials of DP lower than this dissolve/disperse but the lowest limit of DP at which the pliability is suitable for the absorbent napkin is about 110.			(Na—CMC mixing ratio in %) (Durability of maintaining the form of the material)
30				10 When H ₂ O was soaked in the material, its form was not decomposed. 80
				26 Same as above.
				30 The form of the material was somewhat destroyed.
				40 The form of the material was completely destroyed. 85

Comment: When Na—CMC is mixed at 40%, the form is completely destroyed by water. Therefore, the practical limit is 30%.

	(DE of CMC)	(State of dissolution/dispersion)	
35	(1) 0.043	No dissolution/dispersion even after 30 minutes.	EXAMPLE 5 90
	(2) 0.148	Same as above.	5. Experiment on solubility/dispersability of the absorbent when "non-reactive" short fibres are evenly mixed in the absorbent of CMC short fibres. 95
	(3) 0.197	Dissolved / dispersed within about 3 seconds.	Kind, size, form, weight, state etc. of material. Same as those in Example 1.
40	Weight of material. Five grams.		Length of CMC short fibres. Two to 4 millimeters.
	Length of CMC short fibres. Two to 4 millimeters.		Length of untreated short fibres. Two to 6 millimeters. 100
	DP of material. 100—200.		Alkaline agent. NaHCO ₃ 10 grams.
	Alkaline agent. NaHCO ₃ 10 grams.		H ₂ O 1,000 cc.
45	Time of dipping of material. Immediately after throwing alkaline agent into water and stirring up the liquid.		Time of dipping of material. Immediately after throwing alkaline agent into water and stirring up the liquid. 105
			(Mixing ratio of "non-reactive" short fibres in %)
50			10 Good (Solubility-Dispersability) 110
			20 Good
			30 Good
			40 Good
			50 Hardly dissolved/dispersed but dispersed by stirring the liquid.
55	Comment: It is shown from this that the minimum value of DE at which the CMC fibrous mass of DP 100—200 dissolved/dispersed fell within a range between 0.197 and 0.148. It is about 0.150.		60 Same as above.
			70 No dissolution / dispersion even with agitation of the liquid. 120

Comment: When the chemically untreated short fibres are mixed at 70%, the absorbent does not dissolve/disperse. Therefore, the practical limit of the chemically untreated fibres is up to but less than 70%.

EXAMPLE 6

Experiment on DE of a CMC short fibre absorbent which dissolves/disperses under combined use with an alkali source composed of alkali carbonate and acid.

Kind, size, form, weight, state etc. of material. Same as those in Example 1. Length of CMC short fibres. Two to 4 millimeters.

DP of material. 500—600.

Alkali carbonate salt. NaHCO_3 , 10 grams.

Acid. Citric acid 5 grams.

H_2O 1,000 cc.

Time of dipping of material. Immediately after throwing alkali source into water.

(DE of CMC)	(State of dissolution/dispersion)
(1) 0.04	No dissolution/dispersion even after 30 minutes.
(2) 0.14	Same as above.
(3) 0.18	Dissolved/dispersed within 2 seconds.
(4) 0.27	Dissolved/dispersed within 1 second.
(5) 0.34	Same as above.
(6) 0.45	Same as above.
(7) 0.50	Same as above.
(8) 0.70	Same as above.
(9) 0.90	Same as above.

Comment: The minimum value of DE falls with a range between 0.18 and 0.14. It is about 0.15.

EXAMPLE 7

Experiment on dissolution/dispersion of a CMC fibrous mass of low DE, having also low DP of 100—200 as result of immersion of a fibrous mass of DP more than 500 in H_2O for 72 hours.

Kind, size, form, weight, state etc. of material. Same as those in Example 1. Length of CMC short fibres. Two to 4 millimeters.

DP of material. 100—200.

Alkali carbonate salt. NaHCO_3 , 10 grams.

Acid. Citric acid 5 grams.

H_2O 1,000 cc.

Time of dipping of material. Immediately after throwing alkali source into water.

(DE of CMC)	(State of dissolution/dispersion)
(1) 0.043	No dissolution / dispersion even after 30 minutes.
(2) 0.148	Dissolved / dispersed within about 2 seconds.
(3) 0.197	Dissolved / dispersed within about 1 second.

Comment: The minimum value of DE falls within a range between 0.148 and 0.043. It is about 0.10.

Next, the features of the napkin are explained hereunder, with reference to the accompanying drawings in which:—

Figure 1 is a perspective view of the absorbent of the napkin.

Figure 2 is a perspective view of the absorbent of the napkin and an alkali source.

Figure 3 is a perspective view, partly in section, of a napkin ready for use.

Referring to the drawings, CMC made from celluloses such as wood pulp, linter pulp etc. were defibrated to short fibres of less than 1 cm length 1 which were put together and entangled to form a fibrous mass. This fibrous mass was then pressed into such a form as desired which is the absorbent 2 of the napkin.

Figure 2 shows an example of the absorbent incorporating in itself an alkali source consisting of NaHCO_3 and citric acid. The absorbent 2, water-proof material 3 set outside the absorbent to prevent menstrual fluid from leakage, and a methyl cellulose film bag 4, in which NaHCO_3 5 and citric acid 6 are enclosed, are illustrated.

In case of the first mentioned absorbent, the absorbent and the alkaline agent are to be thrown separately into water in a water closet bowl but the incorporation of alkaline agent in the napkin is an improved method in which the disposal of the napkin is more convenient, certain and quick. The reasons are: When the absorbent and the alkaline agent are thrown away separately, two actions are required, however, in case of this incorporation system, only one natural action of throwing the napkin itself will suffice for disposal: Moreover, in case of separate throwing of absorbent and alkaline agent, it is necessary to increase the quantity of alkaline agent to throw in if the quantity of water in the water closet bowl is large. However, in case of this incorporation system, only such a fixed quantity of alkaline agent as to match the quantity of the CMC absorbent, irrespective of the water quantity, is sufficient because the CMC absorbent of the napkin reacts only to the alkaline solution locally generated inside the napkin by reaction of the alkaline agent to the water which has entered into the napkin: Also, there is a feature of prompt dissolution/dispersion of the napkin because the alkaline agent dissolves very quickly in absence of the effect of common ions so that the water in the napkin becomes alkaline easily to cause a reaction to the CMC absorbent: And in addition, when an alkali source consisting of an alkali carbonate and an acid is employed as alkaline agent in case of this incorporation system, there is a feature of instant and positive dissolution/dispersion of the absorbent because of an increased reaction of the CMC absorbent to alkaline

solution, on account of the generation of a large quantity of CO₂ gas.

In Figure 3, a suspender 7 made of paper reinforced by CMC impregnation wraps the absorbent 2. The seams 8 of the suspender are joined together by a water-soluble film 9 of methyl cellulose, poly-vinyl alcohol etc. It is devised so that, when the napkin is thrown into water, the water-soluble film dissolves in water and the paper of the napkin opens wide and then the absorbent dissolves/disperses outside the suspender. But in this case, it is necessary to ensure that this water-soluble film is not dissolved by perspiration of the wear during use, by making the one side of the film water-proof or by covering the water-soluble film with another water-soluble film, one side of which is made water-proof, or putting on the water-soluble film a water-proof material which can be decomposed in septic tank. The location of the seam joint of the suspender with water-soluble film need not to be necessarily on the under side of the suspender but it is more convenient to locate the seam joint at one edge of the suspender because of the location of alkali source to be incorporated. This suspender napkin is to be used by tying its free ends to a suspender belt. There is no fear of its splitting open by perspiration of the wearer because the paper forming it is reinforced by CMC impregnation. Also these papers do not accumulate in a septic tank because CMC reinforcement loses its reinforcing function by swelling in the septic tank and decomposes in accordance with the decomposition of the paper by bacteria in the septic tank. It is also obvious that the absorbent dissolves/disperses in a weak alkaline solution as it is a CMC fibrous mass and therefore, even when the suspender itself does not dissolve in water, it does not cause trouble in its disposal in a water closet bowl as long as the absorbent, which comprises the greater part of the volume of the napkin, dissolves/disperses in water.

In an actual example of the napkin of the invention the absorbent 2 of napkin was prepared by making a fibrous mass of 15 grams of CMC short fibres 1 of DE 0.50 and DP 560 made from a raw material of wood pulp, into an oval form (15 cms in length, 8 cms in width and 2 cms in thickness). Then, a water-proof material 3 of paper impregnated with CMC coated thinly with linseed oil on the surface was inserted below the absorbent to prevent leakage of menstrual fluid and outside of it a bag 4 made of methyl cellulose film

enclosing an alkali source 5 consisting of 10 grams of NaHCO₃ and 5 grams of citric acid was placed. The whole unit was wrapped in a suspender 7 of size 50×12 cms. Thus a suspender napkin was completed. When this was thrown into about 2,000 cc of water in a water closet bowl after use, the water-soluble film 9 applied to the seam joint 8 of the paper of the suspender dissolved at first and the suspender was split. Then, the alkali source incorporated in the suspender contacted H₂O and an active reaction took place, generating a large quantity of CO₂ gas. Subsequently, the CMC absorbent commenced dissolution/dispersion and completely dispersed outside the suspender. The time required from the throw-in of the napkin to the dissolution/dispersion was about 10 minutes. It was then confirmed that, although the suspender did not dissolve/disperse, it did not cause any trouble in disposal in the water closet bowl because the suspender is a soft thin paper.

WHAT I CLAIM IS:—

1. A sanitary napkin comprising (1) an absorbent pad formed from a fibrous mass containing:

(a) at least 10% by weight of carboxy methyl cellulose fibres having a fibre length of less than 1 cm, a degree of etherification of 0.15 to 1.50 and an average degree of polymerisation of more than 100,

(b) 0 to 30% by weight of alkaline carboxy methyl cellulose fibres, and

(c) 0 or less than 70% by weight of short fibres which do not dissolve in or react with alkaline solution, and (2) a solid alkaline agent having a pH of below 10 in aqueous solution at 0.1 mol concentration and room temperature.

2. A sanitary napkin comprising (1) an absorbent pad formed from a fibrous mass containing:

(a) at least 10% by weight of carboxy methyl cellulose fibres having a fibre length of less than 1 cm, a degree of etherification of 0.10 to 1.50 and an average degree of polymerisation of more than 100,

(b) 0 to 30% by weight of alkaline carboxy methyl cellulose fibres, and

(c) 0 or less than 70% by weight of short fibres which do not dissolve in or react with alkaline solution; and

(2) an alkali source comprising solid alkali carbonate and a solid acid.

3. A sanitary napkin according to claim 1

or 2 in which the absorbent and alkali source
or alkaline agent are wrapped in paper rein-
forced with carboxy methyl cellulose.

4. A sanitary napkin according to claim 1
5 or 2 substantially as described herein with
reference to the accompanying drawings.

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FIG. 1

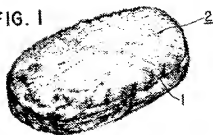


FIG. 2

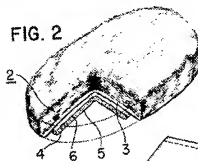


FIG. 3

